

## NOTES ON AUSTRALIAN CESTODES

BY  
P. A. MAPLESTONE  
AND  
T. SOUTHWELL

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In this paper, which is the last of the series, three new species and one new genus are described. Further information relating to the morphological characters of *Monopylidium macracanthum* and *Linstowia echidnae* are also included.

*Bothridium ornatum*, n. sp.

On several occasions specimens of this worm were obtained from Carpet Snakes (*Python spilotes* var. *variegatus*, Gray), taken in the Townsville district.

EXTERNAL ANATOMY.

The largest worm measured about 65 cm. in length, and the greatest breadth was 7 mm.

*Head.* The head measures about 4 mm. in breadth and 5 mm. in length. It consists of two cylindrical muscular tubes, one lying dorsally and the other ventrally. They are attached to each other throughout their whole length by a broad membrane. They are funnel-shaped and are open at both ends, the posterior opening being the smaller and directed inwardly (fig. 1).

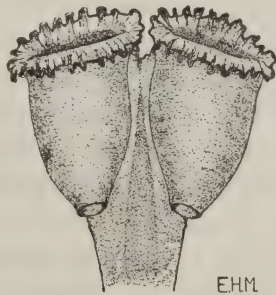


FIG. 1. *Bothridium ornatum*, n.sp. Head.  $\times 9$ .

Unlike *B. pithonis*, the anterior opening is surrounded by a very conspicuous fleshy frill.

*Segments.* These are very numerous, and are all broader than long. The lateral borders are imbricated.

#### INTERNAL ANATOMY.

No points of difference could be observed between this worm and *B. pithonis*, as described by Braun (1900).

#### DIAGNOSIS.

We have compared our specimens with the literature of all the known species of *Bothridium* and find that it differs from them in the characters of the head, viz., the possession of a fleshy frill round the anterior openings. It is proposed to name it *Bothridium ornatum*, n. sp.

Type specimens are in the Museum of the Liverpool School of Tropical Medicine.

#### *Monophylidium fieldingi*, sp. nov.

These cestodes were found in the intestine of several specimens of the Butcher bird (*Cracticus destructor*, Temm.), all of which were shot in the neighbourhood of Townsville, North Queensland.

#### EXTERNAL ANATOMY.

A complete specimen of the worm was not available for examination, so the total length cannot be given, but, from the appearance of several fragments taken together, and the rate of development, it is estimated that a complete adult would be over 50 mm. in length. The maximum breadth attained is 1.2 mm.

*Head.* The rostellum is strongly retracted in all the scolices available for study, with the result that anteriorly, it is in the shape of a truncated cone. The rostellum apparently invaginates when in this state, so that the tip is in the form of a saucer-shaped depression, around the edge of which is a double crown of alternating hooks (fig. 2). The hooks are about forty in number in each row and are of a definite rose-thorn shape when seen in profile; when viewed dorso-ventrally they present a Y-shaped appearance, the handle of which is long and the limbs of unequal length. They measure about  $22\mu$  in length (fig. 3).

The scolex reaches its maximum breadth (about 0.4 mm.) across the posterior borders of the suckers. These organs, when viewed in profile, are seen to stand out slightly from the surface. They are circular in shape, and measure about  $130\mu$  in diameter. They look outwards and slightly forwards, and are unarmed.

Immediately behind the suckers the scolex narrows slightly, and its termination is marked by a somewhat indefinite constriction (probably an artifact), which lies about 0.4 mm. from the anterior end. Immediately behind this constriction is an unsegmented portion about 0.4 mm. in length and 0.25 mm. in breadth. At this point, *i.e.*, about 0.8 mm. from the anterior extremity, the first traces of segmentation appear.

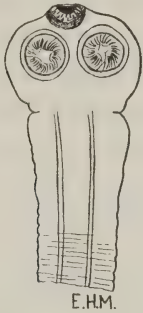


FIG. 2. *Monopylidium fieldingi*, n.sp.  
Head.  $\times 35$ .



FIG. 3. *Monopylidium fieldingi*, n.sp. Hook, highly magnified.

*Segments.* Segmentation soon becomes quite distinct, and the proglottides are seen to have their lateral borders curved, with the convexity outwards, and the postero-lateral angles projecting fairly widely. After about the fiftieth proglottis the length increases slightly more rapidly than the breadth, so that the proportion of breadth to length alters somewhat, but never to such an extent that the length becomes greater than the breadth.

Mature proglottides measure 0.17 mm. antero-posteriorly, 0.4 mm. across the anterior, and 0.47 mm. across the posterior border. The medullary portion at this stage is only 0.170 mm. in breadth.

#### INTERNAL ANATOMY.

The longitudinal muscle consists of relatively thick fibres, which are disposed in two layers, but, as the material was not in a good

enough state of preservation, and was also somewhat scanty, sections could not be cut, and therefore a detailed description of the musculature cannot be given.

*Nervous system.* The details of this system were not investigated.

*Excretory system.* The longitudinal excretory vessels lie at a considerable distance from the lateral borders, so that the medulla is correspondingly narrow. The ventral vessels are uniform in diameter throughout their whole length; they measure about  $20\mu$  in optical section. The narrower dorsal vessel lies directly above the ventral, and the ducts from the reproductive organs pass between them.

*Genitalia.* The genitalia develop slowly, so that there are about one hundred segments showing traces of the sexual organs before they become sufficiently developed to be clearly distinguished.

*Testes.* The testes are circular or slightly oval, and number about sixteen to twenty-one in each segment. When viewed dorso-ventrally they are seen to occupy the space posterior to the female glands, but on each side a few follicles are on a level with the vitellarium, or even with the ovary itself. The vasa efferentia unite into a vas deferens, which is thrown into several coils in front of the right lobe of the ovary. There is no external vesicula seminalis, and the vas deferens passes directly into the base of the cirrus pouch. The cirrus pouch is relatively long and narrow, its dimensions being  $130\mu$  in length and  $45\mu$  in breadth. Beginning mesial to the excretory vessels, it runs towards the right side in all cases, and very slightly posteriorly, and, passing between them, opens in a small atrium, which in turn opens on the right lateral border, about the junction of the anterior and middle thirds. The characters of the cirrus could not be made out (fig. 4).

*Receptaculum and vagina.* The vagina is a long straight tube which commences at the genital pore, immediately posterior to the opening of the cirrus. From here it runs transversely inwards, thus diverging more and more from the cirrus pouch as it goes; it passes dorsal to the right lobe of the ovary, dilating over the ovarian duct into a small but distinct receptaculum seminis.

*Ovary.* The ovary is centrally situated in the anterior half of the medulla. It is approximately bilaterally symmetrical and

consists of three lobes, two pointing laterally and a median lobe pointing anteriorly (fig. 4).

*Uterus.* The uterus develops as a uniform sac devoid of out-pocketings. It eventually fills the entire segment antero-posteriorly and extends laterally to the excretory canals.



FIG. 4. *Monopylidium fieldingi*, n.sp. Ripe segment, showing genitalia.  $\times 69$ .

It is split up into capsules having a reticular form, each capsule containing up to about twelve eggs. Later, a separate capsule appears to be formed around each egg. The uterus was not fully

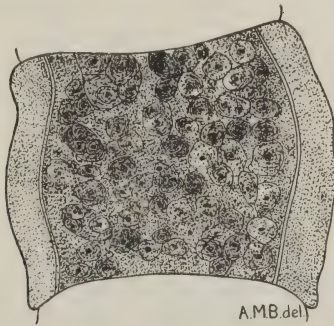


FIG. 5. *Monopylidium fieldingi*, n.sp. Gravid segment.  $\times 28$ .

matured in any specimen, therefore the nature and extent of these capsules could not be determined (fig. 5).

*Eggs.* No ripe eggs were seen.

## DIAGNOSIS.

As this worm possesses all the characters given by Fuhrmann (1899) in the diagnosis of *Monopylidium*, there is no doubt that it belongs to this genus.

As it disagrees with all known species of *Monopylidium*, it is consequently new and accordingly named *Monopylidium fieldingi* after Mr. J. W. Fielding, Senior Assistant at the Australian Institute of Tropical Medicine, who collected this and most of the other material described in this series.

Type specimens are in the Museum of the Liverpool School of Tropical Medicine.

*Monopylidium macracanthum*, Fuhrm.

This worm was found on several occasions in the intestine of the spur-winged plover (*Lobivanellus lobatus*, Lath.).

## EXTERNAL ANATOMY.

Fixed specimens measure about 45 mm. in length, and 1·8 mm. in breadth, but there is apparently some shrinkage from fixation, so that these dimensions will have to be revised when fresh material is available.

There is no trace of a 'neck', the scolex passing directly into the segmented chain.

*Head.* The scolex is about 0·6 mm. in breadth, and is conical anteriorly (fig. 6). The suckers are relatively small, but well

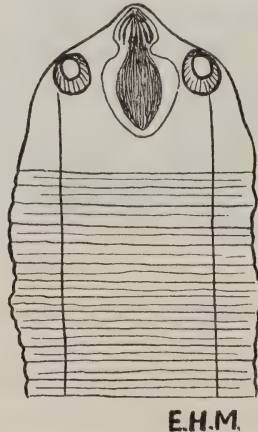


FIG. 6. *Monopylidium macracanthum*, Fuhr. Head.  $\times 35$ .

developed; they measure 0.13 mm. in diameter, and are situated on the scolex just where it begins to narrow anteriorly. They face forwards and slightly outwards. The tip of the scolex bears a rostellum, which was only seen in the retracted state in all the specimens available for examination.

*Rostellum.* The rostellum is a muscular organ, and completely fills the fossa into which it is contracted; this fossa measures about 0.47 mm. in depth and 0.24 mm. in greatest breadth, being oval in shape. The rostellum is seen to consist of two parts, a small anterior conical part and a larger oval posterior portion. The anterior part is distinctly marked off from the posterior by a neck-like constriction. It is armed with a double row of relatively large hooks, which number twenty-six (? twenty-eight). They are of two sizes, alternating, the larger measure  $145\mu$  and the smaller about  $110\mu$ . They have a long dorsal root and blade, and a short ventral root,  $145\mu$  (fig. 6).

The posterior portion of the rostellum is oval in optical section, and, in the contracted state, appears very muscular.

*Segments.* The dimensions of sexually mature segments are about 1 mm. across the anterior, and 1.2 mm. across the posterior borders, so that the postero-lateral angles are only slightly projecting; their length is 0.4 mm., giving a proportion of breadth to length of approximately three to one (fig. 7).

#### INTERNAL ANATOMY.

*Muscular system.* The cuticle is thickly studded with calcareous corpuscles, and the muscle layers are only thinly developed, but their exact disposition cannot be given as there was not sufficient material from which to cut sections.

*Nervous system.* This was not carefully investigated. It was noted, however, that a single nerve ran external to the excretory vessels.

*Excretory system.* The lateral excretory vessels are situated directly one above the other, the dorsal being the narrower. The ventral vessels are joined by a commisural channel, which runs across immediately posterior to the testes.

*Genitalia.* The reproductive organs can first be made out in about the tenth proglottis, and from here on they steadily become more distinct, until they reach maturity. There are about fifty

proglottides sexually mature as far as microscopic characters go, before the uterus becomes apparent.

The genital pores are circular, relatively large and irregularly alternating.

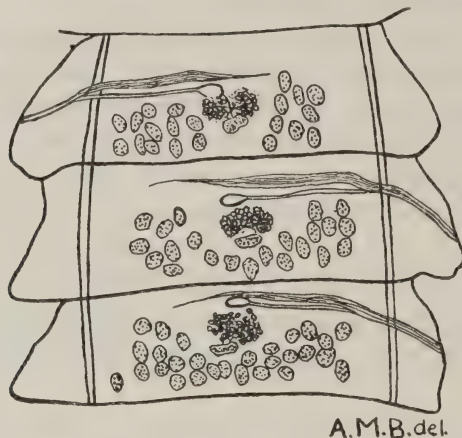


FIG. 7. *Monopylidium macracanthum*, Fuhr. Segments showing genitalia.  $\times 35$ .

*Testes.* The testes number twenty-three to thirty in each segment, and they occupy the usual dorsal position lying on each side of, and posterior to, the ovary when viewed from above (fig. 7).

*Vas deferens.* The various vasa efferentia pass forwards and unite in front of the ovary into a many-coiled vas deferens, which apparently fulfils the function of a vesicula seminalis, as there is no indication of this organ otherwise. These coils lie transversely on the pore side about the junction of the anterior and middle thirds of the segment, and run direct into the mesial end of the cirrus sac. The cirrus pouch is long and thin, and contains a few coils of vas deferens and the cirrus. In its course it runs laterally between the excretory vessels, and, passing slightly posteriorly, opens about the middle of the lateral border of the segment. The characters of the cirrus could not be clearly determined, as it was in all cases entirely within the pouch.

*Ovary.* The ovaries consist of two equal lobes placed one on each side of the mid-line, and each is composed of many subsidiary branches (fig. 7). The anterior border of the ovary is about the



level of the mid-transverse plane of the segment. The lobes each measure about  $80\mu$  in diameter. A duct runs inwards from each lobe and they unite in the mid-line to form the oviduct which joins the fertilisation canal running to the uterus. From this junction a duct passes directly backwards to the vitellarium, and it is surrounded for a little part of its length by the small compact shell gland.

*Receptaculum and vagina.* The vagina opens from the genital atrium, ventral and posterior to the male opening. It is a straight tube which at first follows the posterior border of the cirrus pouch as it passes mesially, but it soon leaves this and runs directly inwards towards the anterior border of the ovary, where it dilates in front of the lobe on the pore side, into a small receptaculum seminis; from the mesial end of the receptaculum a duct passes posteriorly to join with the two branches of the ovarian duct (one from each lobe), where they unite.

*Vitelline glands.* The vitellarium lies behind the ovary in the mid-line. It is a compact body, showing no trace of branching, but is somewhat indefinitely divided into right and left lobes, with the result that the whole organ is more or less kidney-shaped, with the 'hilum' facing forwards. A duct runs from its centre anteriorly, to join the fertilisation canal.

*Uterus and eggs.* The uterus is at first simple, and saccular, but later it splits up into capsules, each containing a single oncosphere. The eggs are circular or slightly oval, being about  $80\mu$  in diameter; the contained embryo measures about  $30\mu$ .

The male copulatory organs persist and are quite distinct even in fully gravid segments, long after all the other reproductive organs have entirely disappeared.

#### DIAGNOSIS.

The presence of a double crown of hooks, identical in size with those of *Monopylidium macracanthum*, Fuhrmann, together with the uterus split up into capsules each containing one oncosphere, leaves no room for doubt that this species is *M. macracanthum*, Fuhrmann. The only point in which it differs is in the number of hooks. Fuhrmann gives twenty-two, whereas in the present species at least twenty-six were seen clearly. As hooks easily become

detached, and further, as their number often varies, no importance can be placed on this difference.

Fuhrmann (1907) originally recorded this parasite from *Helodroncus octopus* in Africa and India, and as his description is somewhat meagre, it was thought desirable to amplify his account when making this new record of the worm in a fresh host and locality, viz., *Lobivanellus lobatus*, from North Queensland.

Type specimens of this cestode were placed in the Museum of the Liverpool School of Tropical Medicine.

*Linstowia echidnae*, Thompson (1893).

D'Arcy Thompson (1893) described a cestode from the Echidna from Australia. In his brief description he mentions that the worms were very contracted.

We have a large collection of immature worms from the same host which, as far as can be ascertained, are the same species. Our material, however, is not so strongly contracted as that of Thompson, and accordingly the condition of the scolex in particular is somewhat different.

As Thompson's description is rather incomplete, the following additional particulars are given.

*Head.* The anterior surface of the scolex is quite devoid of a rostellum, in fact in some cases it has a slight central depression.

The dimensions of the rounded scolex differ slightly in different specimens, varying between 0.76 mm. and 0.58 mm. in breadth. The maximum diameter is just posterior to the suckers.

*Suckers.* The four suckers are placed well forward on the scolex; they are well developed, circular organs, lying flat on the surface, and their openings look outwards and slightly forwards (fig. 8).

*Segments.* At first the proglottides are almost rectangular in shape, broader than long, with no projection of the postero-lateral angles; but as development advances the posterior angles come to project somewhat, with the result that the anterior borders of the segments are shorter than the posterior. The dimensions of the most fully developed segments available for study are 1.6 mm. across the posterior borders, and about 1.35 mm. across the anterior, with a length of about 0.45 mm., being approximately a proportion of breadth to length of three to one. The posterior border is slightly

curved, with the convexity backwards, and to some extent it overlaps the succeeding segment. The cuticle of the worm is thrown into several slightly marked longitudinal folds, which on the

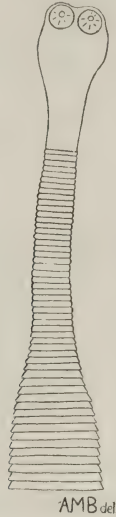


FIG. 8. *Linstowia ecbidnae* (Thompson). Head and anterior segments.  $\times 12$ .

posterior free borders of the segments give an appearance of scalloping (figs. 8 and 10).

#### INTERNAL ANATOMY.

*Muscular system.* Transverse sections show a relatively thick cuticle and cortical parenchyma, and the longitudinal muscle is disposed in two layers, completely encircling the segment, the outer layer being slightly the thicker of the two (fig. 9).

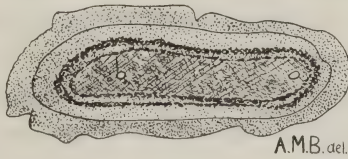


FIG. 9. *Linstowia ecbidnae* (Thompson). Transverse section showing musculature.  $\times 35$ .

*Nervous system.* This system was not investigated.

*Excretory system.* The dorsal excretory vessel is narrower than the ventral, and lies to the outer side of the latter. They both pass dorsal to the ducts of the male and female organs.

*Genitalia.* The genital pores cannot be made out, as in no instance is development complete enough to show them, but from the direction of the immature sex ducts they would probably open about the centre of the lateral border; they are irregularly alternating, there being, as a rule, three or four on one side followed by about the same number on the other side. The reproductive organs are single in each proglottis (fig. 10).

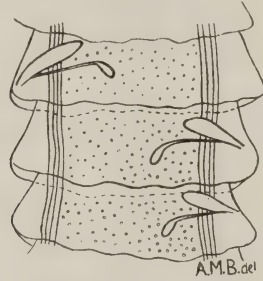


FIG. 10. *Linstowia ecbidnae* (Thompson). Segments showing cirrus pouch and vagina.  $\times 35$ .

*Testes.* Owing to the immature condition of the worms, only traces of the testes can be distinguished. They are numerous and are scattered dorsally across the whole width of the medulla.

*Vas deferens.* No details of this organ can be made out, but it is seen entering the mesial end of the developing cirrus pouch. At the most advanced stage of development observed, the cirrus pouch is represented by a relatively long, straight, tubular structure, which runs inwards and slightly forwards from opposite the centre of the lateral border, so that it lies across the antero-lateral angle of the segment on the side on which it will eventually open.

*Ovary.* This organ lies slightly to the pore side of the median line, and about midway between the anterior and posterior borders of the segment. No details of its structure can be given because it is quite immature.

*Receptaculum and vagina.* The vagina is seen as a straight tube, running inwards along the posterior border of the cirrus pouch, which it leaves about its centre, and running directly inwards, ends in a small expansion, evidently the beginnings of a receptaculum seminis, around which the developing female genitalia can be seen.

On account of the undeveloped condition of the worms, no particulars of the vitelline glands, shell glands, uterus or eggs can be given.

*Paramoniezia suis*, n.g., n. sp.

One specimen was obtained from the intestine of a wild pig (*Sus scrofula*), near Townsville, North Queensland.

EXTERNAL ANATOMY.

The worm is lancet-shaped and measures about 12 cms. in length and 10 mm. maximum breadth.

*Head.* The head is very small and measures only about  $300\mu$  in breadth. It is unarmed and there is no rostellum. The suckers are extremely small; they were too shrunken to give accurate dimensions. There is no neck.

*Segments.* These are always broader than long and their free edges are imbricated. A typical mature segment measures  $200\mu$  in length and 9 mm. breadth. The genital pores are double.

INTERNAL ANATOMY.

*Muscular system.* The longitudinal muscle fibres are arranged in a single layer, composed of numerous bundles measuring about  $60\mu$  thick. External to this is a thin layer of circular fibres. A few dorso-ventral fibres also occur.

*Nervous system.* This system could not be investigated because even the main lateral nerve could only be seen with difficulty.

*Excretory system.* The ventral excretory vessel is very large, and in most transverse sections it appears to occupy the whole of the lateral dorso-ventral space. The diameter of the tube is about  $150\mu$ .

The large size of this vessel, and the numerous branches to which it gives rise, made it difficult to determine whether a dorsal vessel was present or not; but careful examination led us to the conclusion that a dorsal vessel was absent.

*Genitalia.*

*Testes.* These are very numerous (at least three hundred). They extend on each side almost to the lateral extremity of the segment and are not grouped round the ovary, but extend right

across the segment. Each testis measures about  $65\mu$  by  $45\mu$ . Antero-posteriorly they lie in four or five rows, and dorso-ventrally in from one to three layers.

*Vas deferens.* The vas deferens on each side runs dorsal to the ventral excretory vessels. The cirrus pouch is tubular and lies lateral to the water vessel. Its median portion contains an internal vesicula seminalis. No external vesicula seminalis was seen. The cirrus is unarmed.

*Ovary.* This organ is paired in each segment, and is of the usual *Cittotaenia* or *Moniezia* type.

*Receptaculum and vagina.* From the pore the vagina runs inwards, having at first a diameter of about  $60\mu$ ; it expands immediately internal to the excretory vessels into a large transversely elongated muscular sac (the receptaculum seminis) measuring about  $650\mu$  in length and  $150\mu$  breadth. Its median extremity, which lies close to the ovary, is continued as a short coiled narrow tube to the fertilization canal.

A most important point is the fact that whilst the vagina is always ventral to the cirrus pouch on right side, it may be either dorsal or ventral on the opposite side.

*Uterus.* This is first apparent as a cell-string running across the segment. It develops into a tube, devoid of outgrowths, and extends on each side to the extreme edge of the segment.

*Eggs.* The ripe egg has a diameter of  $45\mu$ ; the outer shell has a double contour. The hexacanth embryo measures about  $24\mu$ , and a pyriform apparatus is entirely absent. Between the embryo and the shell a small quantity of yolk can be seen.

#### DIAGNOSIS.

This worm obviously belongs to the family *Anoplocephalidae*, Fuhrm., 1907, and the sub-family *Anoplocephalinae*, Blanchard, 1891. The only two genera within this sub-family possessing double genital pores and a single cirrus pouch on each side are *Cittotaenia*, Rheim., 1881, and *Moniezia*, Blanchard, 1891, and these differ from each other in one particular only, viz., in *Cittotaenia* the vagina is ventral to the cirrus pouch on both sides, whilst in *Moniezia* the vagina is ventral to the cirrus pouch on the right side and dorsal on the left. In the present species the relationship of the cirrus to vagina is variable, the vagina being

sometimes dorsal and sometimes ventral to the cirrus on the left side, in the same strobila.

It is necessary, therefore, to erect a new genus for this species, which we have named *Paramoniezia suis*, n.g., n. sp.

The characters of the new genus are as follows:—*Paramoniezia*. With the characters of the genus *Moniezia*, except that on the left side the cirrus is sometimes dorsal and sometimes ventral to the vagina.

Type specimens are in the Museum of the Liverpool School of Tropical Medicine.

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